Topics

• Industry Standardization & Threaded Connections
• Fluid Power Flanges
• Industry Advancements
• Piping for Fluid Power Systems
  • Phastite for Pipe
• Line Sizing, Routing & Pitfalls
• Hose
• Takeaways
Industry Standardization for Fluid Connectors

General Responsibilities & Goals:

• Safety/Reliability
• Performance Requirements
• Interchangeability
• Grow with users changing requirements
• Similar to IADC, combination of users & manufacturers on technical committees
• Hose, Fittings, Flanges, Transportation Fittings
Product Selection Criteria:

- **S.T.A.M.P.E.D:**
  - **Size**
  - **Temperature**
  - **Application**
  - **Media**
  - **Pressure**
  - **Environment**
  - **Duty Cycle**

- As well as……
  - Sealing/Reliability/Robustness
  - Hose adaptability
  - Inch & metric tube adaptability
  - Installation, serviceability & maintenance
  - Acceptance / Availability / Standardization
Parallel & Tapered Threaded Ports

- Parallel threads serve **one** function
  - holding/retaining the fitting under load
  - **Preferred** connection technology for fluid power systems

- Tapered threads serve **two** functions:
  - For holding in the fitting under load
  - Sealing (plus sealant)
  - **Not preferred** connection for fluid power systems
Threaded O-Ring Ports

**Boss:**
- SAE J1926-1 / ISO 11926-1 (UN/UNF)
- ISO 6149-1 (Metric)
- Adjustability (shapes)
- common
- Standard o-rings

**Boss:**
- ISO 9974 & 1179
- Metric & BSPP thread
- No adjustability – need 2 fittings
- Seals on top of port or port “spotface”
- Often uses special seal

---

O-Ring Boss Port

BSPP or Metric Spotface Port
Tube/Hose End: 37° Flare

- 3 Piece Fitting (aka JIC)
- Common tube/hose adapter
  - Inch & metric tube
  - ¼”/6mm - 2”/42mm
- All metallic sealing
- Tighten by turns or torque
- ISO & SAE Standard
- Torque & vibration sensitive
Tube End: SAE Bite Type/Flareless

- Bite-type ferrule fitting
  - Inch tube only
  - ¼” to 2” tube OD
- Visible/heavy bite
- Common industrial & energy segment fitting
- All metallic sealing
- Limited hose connections
- Sour gas limitations due to 17-4 PH Ferrule

Multiple inspection points to ensure proper/safe bite
Tube/Hose End: *Metric 24° Bite-Type/Flareless*

- Metric bite-type fitting
  - 3 series (LL, L, S)
  - 6mm to 42mm tube OD
- Metric tube only
- ISO 8434 & DIN 2353 standard
- Large breadth of product availability: fittings, weld nipples, banjo fittings, & hose adapter
- All metallic sealing
Tube/Hose End: Metric 24° Soft Seal

- ISO 8434 body/nut
- Separation of sealing & holding functions
- Modified tube attachment methods:
  - Ferrule/Bite-Ring adaptations to include elastomeric sealing
  - Tube forming directly on tube with elastomeric sealing (no ferrule)

Modified “Sealing” Ferrule solution: 
*Courtesy: Parker EO-2*

Cutaways of 3 fitting manufacturer’s solutions (*Parker, Voss, Eaton*) for a formed tube (ferrule-less) option to metric bite type fitting
**Tube/Hose End: O-Ring Face Seal**

- Flat face with a precision o-ring groove
- Tube/hose end has mating 90° surface
- SAE J1454/ISO 8434-3 standard
- Sealing: compressing o-ring between two flat surfaces
- Inch/Metric tube (similar to JIC/37)

Introduced in 1984, O-Ring Face Seal fittings (ORFS) solved many fitting leakage issues of the fluid power industry.
Tube/Hose End: O-Ring Face Seal

- Zero clearance fitting system
- High resistance to over-torque
- Higher temp seals available
  - Elastomeric up to 600°F / 315°C
  - Metallic up to 1200°F / 650°C
- Mechanical forming/flanging
- Weld fittings/glands

Drop-in / zero-clearance feature of ORFS fittings

Mechanically attached and weld attached
Tube/Hose End – Twin Ferrule Compression Fittings

• High-integrity fitting
• Very popular instrumentation fitting
• *Defacto* interchangeability, no industry standard
• Limited tooling required for pre-setting
• Broad range of configurations
• Wide temperature range
• Modest vibration/shock resistance
• Single ferrule fitting option/improvement
SAE/ISO Fluid Power Flanges

- Pipe, Tube & Hose Connections
- SAE and ISO standard flange (SAE J518 / ISO 6162 / ISO 6164)
- Typically used in 1”-5” sizes
- Common platform in **welded** and **non-welded** piping systems
- SAE 4 Bolt: Two pressure classes (3k/6k)
- DIN/ISO 6164: Multiple pressure classes

**Note:** ANSI B16.5 (150# -2500#) flanges are not recommended for fluid power/hydraulic service
Hydraulic Flange Versatility

**Compact 90° Flange**

**Companion Flange**
- Tube to Tube or Pipe to Pipe

SAE Hydraulic Flange to **Hydraulic Hose** using split flanges

**Flange** **Blocks/tees/manifolds**

**Non-Welded** SAE Flange Piping

Confidential 2019 Parker Hannifin Corporation
# Fluid Power Flanges

<table>
<thead>
<tr>
<th>Size (flange)</th>
<th>ISO 6162-1</th>
<th>ISO 6162-2</th>
<th>ISO 6164</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>½“ – 5”</td>
<td>½“ – 3”</td>
<td>1/2” – 5” &amp; larger (proprietary)</td>
</tr>
<tr>
<td>Flange pressure</td>
<td>5000 psi (350 bar)</td>
<td>6000 psi (420 bar)</td>
<td>6000 psi (up to 420 bar)</td>
</tr>
</tbody>
</table>

### Pressure Ratings of SAE Flanges

<table>
<thead>
<tr>
<th>CODE 61 SAE J518-1 / ISO 6162-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>DASH SIZE</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>-8</td>
</tr>
<tr>
<td>-12</td>
</tr>
<tr>
<td>-16</td>
</tr>
<tr>
<td>-20</td>
</tr>
<tr>
<td>-24</td>
</tr>
<tr>
<td>-32</td>
</tr>
<tr>
<td>-40</td>
</tr>
<tr>
<td>-56</td>
</tr>
<tr>
<td>-64</td>
</tr>
<tr>
<td>-80</td>
</tr>
</tbody>
</table>

- UNC or Metric fasteners
- SHCS recommended
- SAE 3000 Pressure ratings
- Small flanges (SAE ½”, ¾”)
- ISO 6162-2 now includes 3”/DN80

Courtesy: Anchor Fluid Power
Hydraulic Flanges - Versatility

Mobile Land Drill Rig

Marine/Shipbuilding

Industrial/Processing

Offshore/Subsea
Advancements in Connectors

- Full SAE J1926/ISO 11926 port depth
- Higher temp o-rings available
  - O-Rings rated up to 600°F / 315°C
- Mechanical forming/flanging
- Higher Pressure Ratings for JIC/37
- Radial / Seal-Sub Flanges
- Non-Welded Hydraulic Piping

SAE J1926-3
SAE J1926-2

JIC Fittings with soft-seal nose/ w/ full J1926 port length (J1926-2)
SealSub Flanges

- Subsea radial sealing flanges
  - SAE J518-2 footprint/bolting
  - Size range ½”-2”
  - Parker, DMIC, Anchor, DTL
  - Pipe Weld, Non-welded piping, Hose, Quick Disconnects
  - No industry standard, SAE reviewing
PIPING
PIPING FOR FLUID POWER SERVICE
Piping vs. Tube

>1 ¼” / 30mm tube OD
Use schedule pipe or non-welded piping system with hydraulic flanges

<= 1 1/4” / 30mm OD
Use tube with hydraulic threaded fittings

In the past, threaded mechanically attached hydraulic fittings were considered reliable only up to ¾”-1” OD – frequently resulting in welded pipe systems being used as small as ½” NPS/schedule pipe
Non-Welded Hydraulic Piping

- Pipe welding imparts challenges for hydraulic systems:
  - High fabrication time & labor
  - Contamination/cleanliness
  - Safety
  - Airborne Chromium/PEL
  - Inspection/NDE
  - Pipe pickling/passivation

Crimp Style

Swage Style

Flare Flange Style

Courtesy: Pyplok

Courtesy: Lokring

Confidential 2019 Parker Hannifin Corporation
Non-Welded Hydraulic Piping

Typical Industry Approach:

• Replacement of SW & BW piping systems
• Crimp, Swage, Groove, Flare
• System of seamless tubes/pipes, flanges, valves, manifolds & clamps
• Couplings and ISO 6162/6164 service break/flanges
• Combined with cold bending
• Combined with service provider
• Carbon steel and stainless Steel
• ASME B31.3
• Typically carry type approval such as DNV and/or ABS to Marine and Offshore Systems
Non-Welded piping

- Welds: 6
- Fittings: 2
- Welding Fabrication Time: High
- Cleaning Time: High
- Flow Characteristics: Abrupt

Non-Welded piping

- Welds: 0
- Elbow Fittings: 0
- Cold bends: 2
- Welding Fabrication Time: N/A
- Cleaning Time: Lowest
- Flow Characteristics: Best
Pipe Cleanliness Comparison
Post Welding, 1st Flushing Bag Comparison

1st Welded Bag Filter
Welded System

1st Non-Welded Filter
Non-Welded System

1" piping, 350 ft / 100 meter run

“The experience of designers and users of hydraulic and lube oil systems has verified the following fact: over 85% of all system failures are a direct result of contamination!” – *The Handbook of Hydraulic Filtration*
Total Welding Comparison

- Review WPS Welder Certification
- Safety Plan/Firewatch
- Welding Consumables and Equipment
- Pipe Painting
- Subcontract Pickling/Passivation
- Certified Weld Inspection (CWI)
- Independent NDT
- Gross Leak and/or Hydrostatic Test
- 1st Weld Pass: Pre-Heat, Weld, Cool, Clean/Grind, Inspect
- Subsequent Weld Passes/Processes:
- Certified Welder
- PPE
- Safety Plan/Firewatch
- Welding Consumables and Equipment
PHASTITE PIPING SYSTEM
NON-WELDED PERMANENT PIPING SYSTEM
Phastite for Pipe

- Stainless steel, permanent, non-welded, axially swaged mechanically attached pipe fitting system
- Designed for rigors of O&G fluid power piping systems
- Currently qualified for common stainless steel hydraulic piping sizes ¾” - 2”
- One fitting series for a wide range of pipe schedules:
  - 40/STD, 80/XS, 160, & XXS
- Tolerance control built into fitting
  - Design accounts for liberal pipe tolerance

One Phastite fitting series for Sch 40/Std to Double Extra Heavy (XXS) pipe schedules
Phastite: Top Level

- For new construction, upgrades, & repair
- All stainless steel construction
  - 316 SS body with high strength duplex SS collar
  - No hidden elastomers, seals, or o-rings on pipe connection
- Pipe Fabrication – from hours to minutes
  - No open flame / hot works permitting
  - No x-ray or certified weld inspection (CWI)
  - No airborne hex chromium exposure
  - Eliminates many pipe welding requirements
    - Gapping, tacking, cool/wait time, grinding, pickling/passivation, clean-up, visual/NDE
Phastite: Design

Before Swage/Compression

Collar/Body Gap Closed

After Swage/Compression
Phastite: Ratings/Approvals

• 6000 psi dynamic/10,000 psi static operating pressure
  • 8k at 3:1 design factor
• Subsea depth of up to 15,000 ft
• Approvals:
  • ASME B31.1/B31.3 piping rules compliant
  • DNV-GL Technical Qualification (TQ) 2013 (subsea, offshore, topside O&G)

TQ Certificate for Phastite.
Phastite – Additional Considerations

- Zero heat application process
- Pre-assembled fittings with no loose parts
- A visual validation of a leak-tight connection (*close the gap*)
- Highly vibration tolerant
- Clean: requires *no added lubrication*
- 100% traceable (HCT) manufacturing
- Use with standard ASTM A312 S/S pipe
- Highly corrosion resistant
- Connects in minutes with hydraulic too
Phastite Fabrication

- Workbench mounted assembly tool
  - completes the Phastite connection in 1-2 minutes in 4 easy steps
  - 10x the speed of welding
- A greater labor impact is realized when combined with cold bending

1. Inspect pipe with go/no-go gauge
2. Insert pipe & fitting into Phastool
3. Swage
4. Visually inspect ready-to-use assembly.
Phastite: Extensively Tested and Validated

Bending Test

Hyperbaric Chamber Test

ASTM G44 Splash Zone Test
Extensively Tested and Validated

Burst Test to ASTM F1387

Axial Tension Test to ASTM F1387

Vibration Test to ASTM F1387. Vibration Under Internal Pressure of 10,000 PSI for 250,000 Cycles
ADDITIONAL GUIDELINES
LINE SIZING, ROUTING, PITFALL AVOIDANCE
Fluid velocity guideline:
• 3-4 ft/sec max for suction lines
• 8-10 ft/sec max for return lines
• 18-22 ft/sec max for pressure lines

Note: Tube is sized by OD, Hose is sized by ID. Important for Flowpath matching
Routing

Takeaways: square and parallel, allow for expansion/contraction, PLAN for service breaks, PLAN for service/access to connections
Installation

Wedging or forcing a threaded or flanged connection in place will lead to premature failure or leakage!

If you have to use a cheater bar........
Clamping

Several manufacturers provide industry standard (DIN 3015) clamps to the industry.

Instrumentation tube clips
Clamping Guidelines

Published Spacing Guidelines

Published Load & Shear Force - *Courtesy Stauff*

*Avoid “buddy clamping”*

*Double Heavy Clamp - Courtesy Stauff*
Hydraulic Hose Selection

• What is the Application of the hose?
  • Equipment Type
  • Suction/Pressure/Return

• Where will the hose be used?
  • Temperature & corrosion
  • Minimum Bend Radius
  • Routing requirements: clamps/protection sleeves
  • Duty cycle
  • Abrasion (external)
  • Media (internal)
  • Fitting/adapter selection
  • Specific hose construction (spiral, braided, low volumetric expansion)
Hose Routing

Needs Improvement

Preferred

Min 2x Hose OD

Needs Improvement

Preferred

Preferred

Needs Improvement

Preferred

Confidential 2019 Parker Hannifin Corporation
Hose Routing/Safety

- Typical hydraulic hose expands in diameter & shortens in length when pressurized
- Thermoplastic hose for subsea service
- Follow velocity guidelines
- Flex connect at HPU and equipment takeover points when possible
- Hose is not an accumulator
- Don’t intermix manufacturer’s fittings/hose/crimping system
Avoid Hose Twist

Use two wrenches to install a hose assembly. This will reduce chance of hose twist.

“a twist in a hose as little as 7-10% can result in a 90% loss of service life in the hose….“ Use the layline of the hose as a guide to determine if there is hose twist

*Source: International Fluid Power Society*
Summary

Energy loss
Safety hazards
Environmental responsibilities
Maintenance costs
Lost Sales
Warranty
QUESTIONS?